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A NEW SPECIES OF *FOLIOCEROS* BHARAD. (ANTHOCEROTACEAE) FROM ARUNACHAL PRADESH, INDIA

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INTRODUCTION

The genus *Folioceros* Bharad. was instituted to accommodate the taxa earlier referable to *Aspiromitus* St., as the latter militated against the rules of the Botanical Nomenclature and was thus rendered invalid (Bharadwaj, 1971). Besides, certain species of the genus *Anthoceros* L. emend. Prosk., having dark, spinose or baculate spores and possessing long, septate elaters with highly thickened walls and narrow lumen, were also referred under *Folioceros*. Subsequently, a number of Anthocerotalean taxa of Indo-pacific and Afro-asian origin have been transferred to the new genus (Bharadwaj, 1972, 1973, 1975, 1978). Apart from that three new species of the genus; *F. assamicus* Bharad., *F. indicus* Bharad. and *F. pandei* Udar *et* Shaheen have also been described from the country (Bharadwaj, 1971, 1978; Udar & Shaheen, 1982). Recently a survey of the Anthocerotalean specimens, collected from the West Kameng district of the Arunachal Pradesh, had revealed an interesting population of the genus from Tipi. A subsequent critical morphotaxonomic investigation has revealed them to constitute a new taxon, which is described in the present communication as *Folioceros paliformis* Singh, sp. nov.

Folioceros paliformis Singh, sp. nov.

Planta dioica, repetite ramosa, frondes lineares, ordinatim pinnatim lobatae, marginatae vallo cellularum oblongarum, unicellulari crasso; thalli pagina dorsalis saepe papillas clavatas mucosas ferens; chloroplastus magnus, sphaeroideus, conspicue tuberculatus cum parte centrali pyrenoidali distincta; androecia in quoque loculo cum 20-24 antheridiis, loculi apertura plerumque papillis mucosis tecta; involucra sulcata, papillis rosulatis lamellisque crenulatis peltatis multiformibus instructa; cellulae epidermales parietibus tenuibus, hyalinis; stratum exterius parietis capsulae non inspissatum; elateres 155-500 µm longi, 6-15 µm lati, pariete sinuato spissescenti; sporae pallide brunneae, spinulosae et baculosae, signum tetradis indistinctum.

Holotypus: Prope Tipi, West Kameng District, Arunachal Pradesh, India, leg. et det. D.K. Singh, *Singh* 11671 (CAL) *Isotypus :* ASSAM.

Dioecious. Plants light green-pale green, caespitose, growing on gritty soil over rocks; fronds repeatedly branched, lobes more or less obcuneate, regularly pinnately dissected, margins lined by compactly arranged palisade of single row of oblong cells, dorsal surface somewhat corrugated, frequently beset with long, cylindrical or clavate mucilage papillae; thalli cavernose, with 1-3 layered schizogenous cavities copiously filled with mucilage, epidermal cells quadrate-subquadrate, 24.5-70 × 14-63 µm in size, with a single (rarely two also) large chloroplast which is highly dissected and attached to the inner cell walls, with more or less spheroid and conspicuously tuberculate central pyrenoid region; hypodermal cells usually with two chloroplasts, with the central pyrenoid region not discernible; inner cells in cross-section amoeboid in outline. *Nostoc* auricles large, spheroid; rhizoids smooth walled, usually hyaline. Male plants repeatedly branched, forming more or less semirosettes of up to 10 mm radius, lobes up to 10 mm long, 2-3 mm wide; androecia regularly arranged in a single row along the mid-dorsal line of each lobe, conspicuously projecting above the dorsal surface, protruding portion more or less conical in outline, with the distal part of the body anteriorly oriented, opening through a small circular pore lined by six cells, the mouth of the androecium usually guarded by mucilage papillae; antheridia 20-24 (at different stages of development because of secondary formations) in each androecium, orange coloured, clavate, with the body 185-225 μm long, dehiscing through the separation of apices of the cells of upper most tier of the antheridial jacket, cells of the jacket layer usually arranged in 4 tiers, often with a tendency towards irregular arrangement also. Female plants also repeatedly branched, with the lobes arranged in a more or less obtriangular-obcordate fashion, lobes 12-20 mm long, 3-7 mm broad; involucres occurring singly, usually two in a row along the mid-dorsal line on each lobe, 3-5 mm long, with the mucilage canals arranged in single layer, conspicuously bulging on the outer surface, making it sulcate in appearance, surface beset with rosulate papillae, and variously shaped, unistratose, crenulate, peltate lamellae, epidermal cells thin walled, hyaline; sporophytes 15-25 mm long, cylindrical with obtuse apex, dehiscing longitudinally, valves twisting spirally on dessication, capsule wall reddish brown, 7-8 cell layers thick, epidermis sparsely stomatiferous, with 6-16 stomata occurring per sq. mm, guard cells placed at slightly different level, 45-56 μm long, 10-15 μm wide, epidermal cells narrow, elongated, 175-245 μm long, 14-32 μm wide, in cross-section quadrate to subquadrate, with slightly convex outer walls, thickenings uniformly present on the radial and outer tangential walls; cells of the lining layer with pale or purple pigmentation, sometimes projecting into the archesporial chamber; columella consisting of 30-36 vertical rows of cells, marginal cells often projecting tangentially; spores light brown, globose (25-35 μm in diameter)-subglobose or oval (25-35 × 28-35 μm), exine double sculptured, ornamented with minute baculae as well as spinules on both the surfaces, tetrad mark often indistinct, proximal and distal faces indistinguishable at maturity, young spores proximally have a tricolpate, hyaline area; elaters quite fragile, branched or unbranched, obliquely septate, 155-500 μm long, 6-15 μm wide, walls usually with conspicuous sinuate thickenings, lumen excessively narrow.

D.K. Singh 11671, April 16, 1982, Tipi, *ca* 300 m, West Kameng district, Arunachal Pradesh, India. Det. D.K. Singh (Holotype-CAL; Isotype-ASSAM).

Characteristics of the species: (1) Margins of the thallus lobes lined by compactly arranged one layer of palisade cells (2) Dorsal surface of the lobes frequently beset with mucilage papillae (3) Epidermal cells of the thallus having a single, large, highly branched chloroplast with 1(-2), conspicuously tuberculoid central pyrenoid region (4) Androecial opening bordered by six cells, usually guarded by mucilage papillae (5) Cells of the antheridial jacket often tending towards 'Phaeoceroid' arrangement. Body of the dehisced antheridia measuring 185-225 μm in length (6) External surface of the involucres profusely beset with rosulate papillae and peltate lamellae (7) Remarkably massive columella, consisting of 30-36 vertical rows of cells (8) Double sculptured spores with baculose and spinulose sporoderm pattern (9) 155-500 µm long, usually 4-celled but fragile, branched or unbranched elaters with sinuate wall thickenings

Folioceros paliformis is considerably interesting in its external morphology and differs from most of the species in this feature. While the dorsal surface of the thalli have abundant mucilage papillae (Fig. 4), the surface of the involucres is profusely beset with rosulate papillae (Figs. 13-16) and peltate lamellae (Figs. 11-12). The lamellar outgrowths over the surface of the thallus and involucres are not uncommon amongst the members of Anthocerotales (Cavers, 1910; Bharadwaj, 1950; Proskauer, 1948; Renzaglia, 1978; Udar & Singh, 1981), as also in the genus *Folioceros* (Udar & Shaheen, 1982). However, the presence of rosulate papillae on the surface of involucres in this species is quite significant as there seems to be no such report in any member of the Order Anthocerotales. Besides, while the mucilage papillae, present on the thallus surface, are suggestive of an adaptation possibly to endure comparatively dry and exposed conditions of its growth, the peltate lamellae, observed on the surface of involucres, show a structural analogy with the dorsal gemmae of certain members of the Order Metzgeriales, such as *Blasia* L. and *Cavicularia* St. The present species, significantly differs from hitherto all the known species of the genus, in these characteristics.

In evolving the taxonomic concept in the genus *Folioceros,* Bharadwaj (1972) assigned considerable significance to the features like sexuality of the plants; size of the body of a mature antheridium; stomatal frequency in the capsular epidermis; spore morphology, including its size, and the size of elaters. A combination of these characters distinguishes the present species from other species of the genus known so far. But in the presence of one cell thick palisade of oblong cells (Figs. 1-3) it partially resembles *F. assamicus* Bharad., *F. falsinervius* (Lindbg.) Bharad., *F. miyabenus* (St.) Bharad. and *F. physocladus* (Schiffn. & Pande) Bharad. However, it is distinctive and differs considerably from them in the chloroplast structure (*F. assamicus* and *F. miyabenus* have single chloroplast, more or less like a spongy moss of network devoid of any central pyrenoid region, whereas *F. falsinervius* has a single, orbicular to suborbicular chloroplast without central pyrenoid region and *F. physocladus* has 2-3 chloroplast, ornamented with tubercles and devoid of pyrenoid); number of antheridium in each androecium and its size (*F. assamicus* and *F. miyabenus* have 8 antheridia per chamber, with their body measuring 150-175 µm and 138-155 µm respectively, whereas in *F. falsinervius* there are up to 25 antheridia, measuring 175 µm in length and *F. physocladus* has up to 30 antheridia, measuring 155-170 µm); spore morphology and exine ornamentation (all the four species have exclusively apolar spore with baculate sporoderm, while in *F. assamicus, F. falsinervius* and *F. miyabenus* baculae are with dentate apices, in *F. physocladus* they are laevigate); and the size of elaters (in *F. assamicus* 300-410 µm long, 5-10 µm wide; in *F. falsinervius* 350-500 µm long, 5-10 µm wide; in *F. miyabenus* 350-550 µm long, 5-10 µm wide and in *F. physocladus* 530-630 µm long and 5-8.5 µm wide). *F. paliformis* further differs from *F. falsinervius* and *F. miyabenus* as the latter are strictly monoecious species. The present species is also considerably distinctive in having a very massive columella, consisting of 30-36 vertical rows of cells as against 16 rows normally present in anthocerotalean columella and a double sculptured sporoderm, combining both the baculae (with laevigate apices) and spinules, with more or less mamillate base, together.

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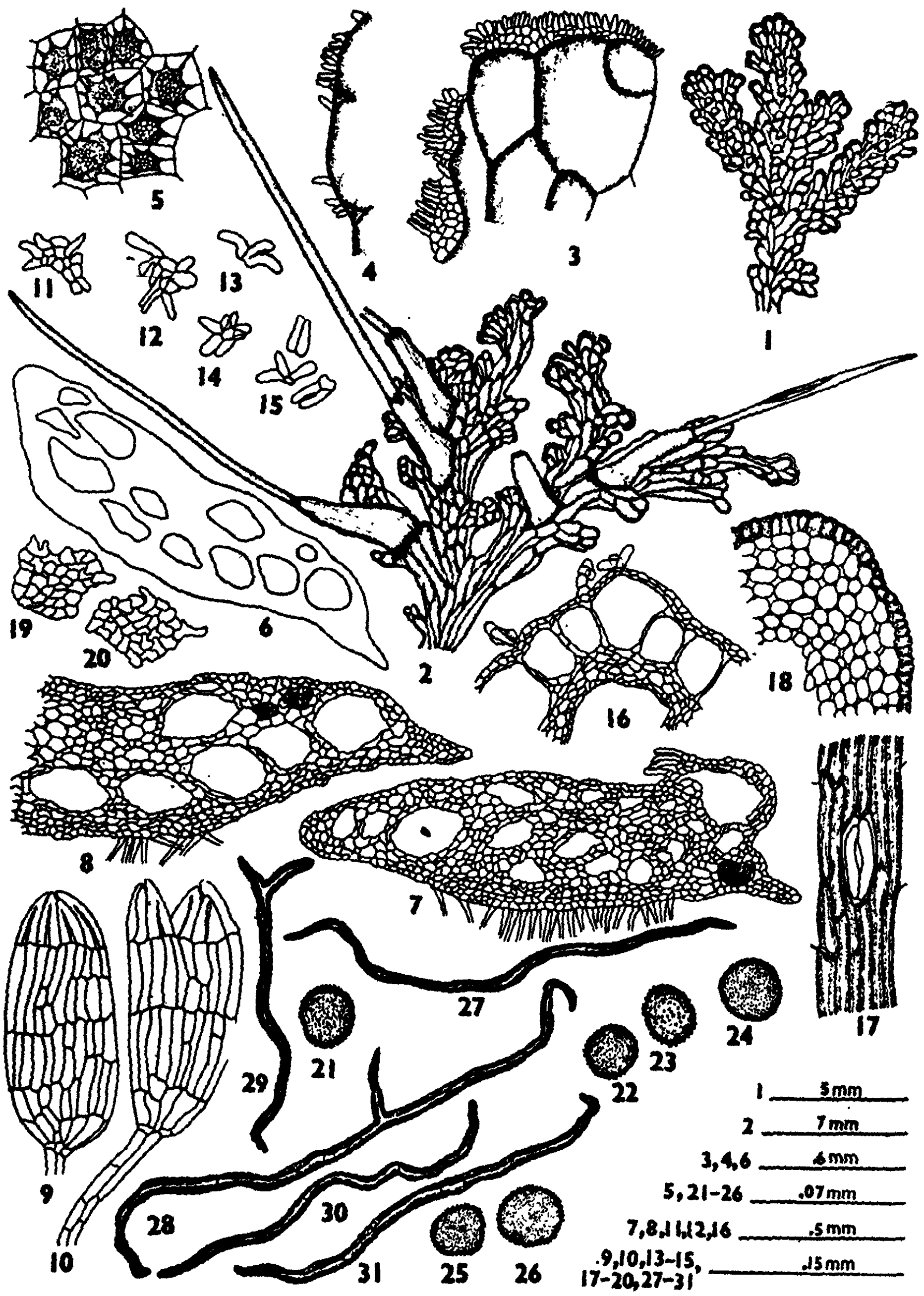

Folioceros paliformis Singh, sp. nov.

Figs. 1–31 1. A portion of the male frond, in dorsal view. Note the androecia arranged along the mid-dorsal line 2. A portion of the female frond, in dorsal view. 3. A portion of the thallus lobe, highly magnified. Note the unistratose wing and one layer of palisade of oblong cells. 4. A sector of the dorsal surface of the thallus. Note the mucilage papillae. 5. Epidermal cells of the thallus with chloroplast. Note the more or less tuberculoid pyrenoid region. 6-8. Cross-section of the thallus. 9. A antheridium. 10. A dehisced antheridium. 11, 12. Peltate lamellae from the surface of the involucres 13-15 Papillae from the surface of involucres. 16. Cross-section of involucre. 17. A portion of the capsule wall epidermis, showing stomata. 18. Cross-section of the capsule (only a portion drawn, columella not shown). '19, 20. Cross-section of columellae. 21-26. Spores. 27-31. Elaters.